R1838 (Revised)

SAMPLING KITS

NDSU Extension

Range and Forage Production

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Accurately calculating range and forage production of grazing resources is important when estimating carrying capacity and stocking rate. The most accurate method to calculate forage production is the clip-and-weigh method.

This method requires the harvesting of standing forage at a given time to predict available forage. The available forage is measured by hand clipping and weighing a specified number of plots within a grazing/forage production area.

These plot weights are averaged to account for variability in production across the field or pasture to be grazed. The average plot weights then are multiplied by a conversion factor to determine the approximate pounds per acre of production.

This production parameter only provides a measurement of plant production and not necessarily forage production because some of the weight may be weedy species that livestock may not consume. To avoid overestimating the stocking rate, clip only the plants found within your frame that the scheduled class of livestock will consume.

The following supplies are required for your Range and Forage Production Sampling Kit:

- Range hoop/frame (Refer to the appropriate pasture or field type section below to determine best frame size to use)
- Clippers
- Scale to measure weight in grams
- Paper/plastic bag to place clipped forage in for weighing
- Markers to label bags
- Paper or forms to record data
- Pen or pencil to record data

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Calculating Production

When calculating forage production, use the following protocol:

1. Select sample sites to clip within the grazing unit, being careful to represent any variation (kinds and amount of plants) in forage composition and production. The number of sites selected will depend on the type of grazing resource and uniformity of vegetation; refer to the appropriate pasture or field type section for recommendations on the number of frames. The size and shape of the plots depend on the type of forage to be sampled. Frames can be circular, square, rectangular or linear (Table 1). Sample sites should be selected randomly within each sampling area.
2. Clip plants within the frame that will be consumed by livestock and/or wildlife. Total biomass is determined by harvesting the whole plant, clipping to ground level. If a shrub is within the frame and is a type that will be consumed, only harvest the current year's growth. When clipping, include plants whose stems originate within the frame and collect all above-ground parts that extend beyond the frame boundary, irrelevant of height. Do not clip plants with stems outside of the frame, even though some plant parts may overlap the frame.
3. Harvest, weigh and record the weight for each frame. Then calculate the average weight in grams, remembering to subtract the weight of the empty bag from the weight of each sample.
4. After all forage is weighed, determine air-dried weight. The recommended method is to air-dry the harvested material. Typically, harvested material is collected in paper bags and placed in a dry area with exposure to direct sunlight for several days to air-dry the material. Air-dried weights also can be estimated by selecting the appropriate factor from Table 2 and multiplying by this percentage to get air-dried weight.
5. Next, multiply the average dry weight by the conversion factor for the frame (refer to the appropriate pasture or field type section below or Table 1). This number will be equal to the weight in pounds per acre.
6. Finally, multiply the weight in pounds per acre by the area (in acres) of the grazing unit (pasture/field) to determine forage production.

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Pasture or Field Type to be Grazed

Range and Pasture, Small Grains, Solid-seeded (Broadcast) Crops and Cover Crop Mixtures

Number of plots: five to 15 (depending on diversity of ecological sites/forage suitability groups/soil types – the more ecological site or soil types, the more plots clipped)

Clipping area: 1.92-square-foot area

Conversion rate: 50

Row Crops

Number of plots: three

Clipping area: We recommend that the length be divided between two adjacent rows.

- 22-inch row spacing: length of 6 feet
- 24-inch row spacing: length of 5 feet 6 inches
- 30-inch row spacing: length of 4 feet 3 inches
- 36-inch row spacing: length of 3 feet 8 inches

Conversion rate: 8.92

Clipping length is calculated as
10.8 ÷ (row spacing in inches ÷ 12) = length in feet

Make sure samples represent the variation within the grazing unit. The more variability in the pasture and forage growth, the greater the number of samples necessary. In crop settings, collect more samples if the stand is not uniform.

Table 1. Common plot sizes and conversion rates.

Plot Area (ft^2)	Plot Circumference (inches)	Plot Dimensions (inches)	Conversion Rate
1.92	58.94	16.632 x 16.632	50
10.76	139.56	39.36 x 39.36	8.92

Adapted from the U.S. Department of Agriculture Natural Resources Conservation Service National Range and Pasture Handbook

Table 2. Percent of air-dry matter of forages by stage of growth.

	Before Heading – Initial growth to boot stage	**Headed** – Boot stage to flowering	**Seed Ripe** – Leaf tips drying	**Leaves Dry** – Stems partly dry	**Dormancy**
Cool-season Grasses					
Wheatgrasses, needlegrasses, perennial bromes, bluegrasses, fescues, annuals such as oats, barley	35%	45%	60%	85%	95%
Warm-season Grasses					
Tall: bluestems, switchgrass, corn, sorghum, millet	30%	45%	60%	85%	95%
Mid: side-oats grama, teff	40%	55%	65%	90%	95%
Short: blue grama, buffalograss	45%	60%	80%	90%	95%
Other Range or Pasture Plants					
Forbs	20%	40%	60%	90%	100%
Shrubs	35%	50%	30%	85%	

Adapted from the USDA NRCS National Range and Pasture Handbook

Example 1

To determine production of a meadow brome pasture, clip five 1.92-foot^2 frames using the air-dry method.

1. Record the wet weight for each plot, subtracting the bag weight (5 grams in this example).
2. Air-dry the samples and reweigh to determine the dry weight of each sample, subtracting the bag weight of 5 grams.
3. Determine the average dry weight of the five samples = 41 grams
4. Multiple the average dry weight by the conversion factor: 41 grams x 50 = **2,050 pounds/acre**

Plot	**Total Weight** (grams) – includes bag	**Wet Weight** (grams) – minus bag	**Percent Air-dry Matter**	**Dry Weight** (grams)
1	98	93	35.5	33
2	120	115	33.9	39
3	113	108	36.1	39
4	150	145	35.2	51
5	135	130	33.1	43
Average Dry Weight: 41				

Example 2

To determine production of a meadow brome pasture, clip five 1.92- foot^2 frames and multiply by dry weight conversion. Meadow brome grass is in the before-heading growth stage (Table 2).

1. Record the wet weight for each plot, subtracting the bag weight (5 grams in this example).
2. Multiply weight by 35% (0.35, Table 2) to determine the dry weight of each sample, subtracting the bag weight of 5 grams.
3. Determine the average dry weight of the five samples = 42 grams
4. Multiple the average dry weight by the conversion factor: 42 grams x 50 = **2,100 pounds/acre**

Plot	**Total Weight** (grams) – includes bag	**Wet Weight** (grams) – minus bag	**Percent Air-dry Matter**	**Dry Weight** (grams)
1	98	93	35	33
2	120	115	35	40
3	113	108	35	38
4	150	145	35	51
5	135	130	35	46
Average Dry Weight: 42				

Example 3

To determine production of a row crop seeded at 30-inch row spacing to be used as pasture, clip three separate locations containing two rows at a length of 4 feet, 3 inches long and multiply by dry weight conversion. Plant mixture used in this example is sorghum-sudangrass harvested at the heading stage (Table 2).

1. Record the wet weight for each plot (3), subtracting the bag weight (15 grams in this example).
2. Multiply weight by 45% (0.45, Table 2) to determine the dry weight of each sample, subtracting the bag weight of 15 grams.
3. Determine the average dry weight of the three samples = 365 grams
4. Multiple the average dry weight by the conversion factor: 365 grams x 8.92 = **3,256 pounds/acre**

Plot	**Total Weight** (grams) – includes bag	**Wet Weight** (grams) – minus bag	**Percent Air-dry Matter**	**Dry Weight** (grams)
1	808	793	45	357
2	894	879	45	396
3	778	763	45	343
Average Dry Weight: 365				

Summary

Once you determine the forage production for a grazing resource, you can calculate carrying capacity and stocking rate.

Determining the carrying capacity and establishing the proper stocking rate is important for optimizing forage production and maintaining animal performance while ensuring the sustained health and production of the grazing resources. Refer to NDSU Extension publication "Determining Carrying Capacity and Stocking Rates for Range and Pasture in North Dakota" (R1810) and the "NDSU Grazing Calculator" (https://www.ndsu.edu/agriculture/ag-hub/ag-topics/livestock/tools/grazing-calculator-app) for more information on completing these calculations.

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For more information on this and other topics, see **ndsu.edu/agriculture/ag-hub**

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